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SPUTTERING APPARATUS [Supataringgu Sochi]

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FOREIGN TITLE [54A]: Supataringgu Sochi Specification

1 Title of the invention Sputtering Apparatus

2 Claims

1 A sputtering apparatus, characterized by being equipped with a magnetic material target; magnets for generating a magnetron discharge on the target; a yoke for guiding a magnetic flux being generated from the magnets; and a magnetic flux density variable means for regulating the size of the magnetic flux density in a discharge atmosphere on the above-mentioned target.

2 The sputtering apparatus of Claim 1, characterized by the fact that the magnetic flux variable means is equipped with a driving gear that can change the relative distance between the magnets and the target.

3. The sputtering apparatus of Claim 1, characterized by the fact that the magnetic flux density variable means is equipped with a magnetic flux short-circuit member that can short-circuit part of the magnetic flux between the

magnets and the target.

[1] Numbers in the margin indicate pagination in the foreigntext.

3 The sputtering apparatus of Claim 1, characterized by the fact that the magnetic flux variable means is equipped with a driving gear that can change the relative distance between the magnets and the yoke.

3. Detailed explanation of the invention

(Industrial application field)

The present invention pertains to a sputtering apparatus that sputters a magnetic material target by utilizing a magnetron discharge and forms a thin film on a sample. (Prior art)

In a magnetron method, electrons are introduced into an electric field and a magnetic field chain-intersecting with each other, and a discharge is induced by a cycloid motion. In sputtering utilizing the magnetron discharge, these electric field and magnetic field are formed on a target in a discharge atmosphere, and said target side is set to a cathode. Cations generated by the discharge are drawn aside to the above-mentioned target, so that target molecules are sputtered. Then, this method is characterized by the fact that magnets are arranged at the lower side of the above-mentioned target, and a magnetic material with high permeability is sometimes used as the target. /2

(Problems to be solved by the invention)

On the other hand, the magnetic fluxes being generated from the magnets are branched to the magnetic flux that penetrates into the magnetic material target and arrives at the discharge atmosphere and the magnetic flux that connects the targets in the target. However, the amount of magnetic flux being saturated, which connects a magnetic path in the target, depends on the material and the shape of said target, and if the target material is thinned by the use over a long term, the amount is gradually decreased. As a result, the amount of magnetic flux arriving at the discharge atmosphere is increased as much, and the state of the magnetron discharge is changed, so that a thin film with thickness and properties equal to those of the prepared thin film cannot be obtained.

The present invention considers the above-mentioned troubles, and its purpose is to realize a sputtering apparatus using a magnetron method that always constantly maintains the magnetic flux density on a target and has no influence on the thickness and the properties of a thin film being prepared by rendering a function as a hardware capable of correcting the change of the magnetic flux due to the consumption of the target to the long-term use of the sputtering apparatus.

(Means to solve the problems)

In order to achieve the above purpose, the following means are adopted.

In other words, the sputtering apparatus of the present invention is characterized by being equipped with a magnetic material target; magnets for generating a magnetron discharge on the target; a yoke for guiding a magnetic flux being generated from the magnets; and a magnetic flux density variable means for regulating the size of the magnetic flux density in a discharge atmosphere on the above-mentioned target.

Also, as the magnetic flux variable means, a means for regulating the amount of magnetic flux arriving at a discharge atmosphere by changing the magnetic resistance through a gap in a magnetic path or discharging the magnetic flux is especially appropriate. (Operation)

According to this means, even if the magnetic density of the discharge atmosphere is changed by the long-term use of the sputtering apparatus, since the amount of arriving magnetic flux can be changed by the magnetic flux variable means, the amount being changed can be canceled. Thus, regardless of the sectional shape of a target material being used and its amount being consumed, a stable

magnetron discharge can always be induced, so that a thin film with equal qualities can be repeatedly, continuously formed on oppositely arranged samples.

(Application examples)

Next, application examples of the case where the sputtering apparatus of the present invention is constituted by a parallel tabular type are explained referring to the figures. First application example

In this application example, as shown in Figure 1, several permanent magnets 2 are symmetrically arranged on a yoke 1, and these magnets 2 and the above-mentioned yoke 1 are enclosed with a housing 3. Then, a packing plate 4 is placed between upper ends 3a of the side walls of the housing 3, and a magnetic material target 5 is set on it.

On the other hand, a magnetic flux variable means 6 of this application example is equipped with a driving gear 7 capable of changing the gap between the above-mentioned magnets 2 and the target 5 by changing the relative distance between both of them. The driving gear 7 is equipped with an arm 7a being protruded by driving of motor, actuator, etc., (not shown in the figure), and the arm 7a is penetrated into a bottom plate 3b of the housing

3 via a guide 7b and mounted at a bottom part 1a of the above-mentioned yoke 1, and along with said yoke 1, the magnets 2 can be ascended and descended as shown by an arrowhead I with respect to the target 5.

The relationship amount of the magnetic flux density Bm of magnetic fluxes being generated from the magnets, the magnetic flux density Bs of magnetic fluxes that penetrate into the target 5 and form a toroidal magnetic field in the discharge atmosphere, and the magnetic flux density Bt of magnetic fluxes passing through the above-mentioned target is established as follows, regardless of the gap.

$$Bm = Bt + Bs \quad (1)$$

Now, if the target 5 is consumed and Bt and Bs are respectively changed to Bt1 ($Bt > Bt1$) and Bs1 ($Bs1 > Bs$), since the following is still established

$$Bm = Bt1 + Bs1 \quad (2)$$

the relationship between Bs and Bs1 is attained from the equations (1) and (2).

$$Bs1 = Bs + (Bt - Bt1)$$

On the other hand, the magnetic flux density, as shown in Figure 4, is reduced as they are separated from /3 the magnets. Then, utilizing this property, the magnetic resistance of the gap is increased by descending the

magnets 2 with respect to the target 5 through the operation of the driving gear 7 until the magnetic flux density Bs1 of the magnetic fluxes arriving at the discharge atmosphere D is reduced by (Bt - Bt1), so that the incremental portion of the magnetic fluxes can be canceled.

Also, even in a constitution in which the magnets 2 are fixed and the target 5 is ascended and descended, needless to say, an effect similar to that of this application example can be obtained. Second application example

This application example, as shown in Figure 2, has a constitution approximately similar to that of the above-mentioned first application example, and the same symbols are given to the common parts.

In this application example, the yoke 1 is directly placed on the bottom plate 3b of the housing 3, and the magnetic density variable means 6 is equipped with a short circuit plate 8 with a thin plate shape as a magnetic flux short-circuit member capable of short-circuiting magnetic fluxes. The short circuit plate 8 is arranged between the magnets 2 and a housing plate 4 by a mounting member not shown in the figure.

In this application example, if the short circuit plate 8 being saturated with a magnetic flux Bp equal to the amount (Bt - Bt1) of magnetic flux being increased due to the consumption of the target 5 is used, the incremental portion of the magnetic flux density of the discharge atmosphere D can be canceled. Also, the short circuit plate 8 may be increased in accordance with the change of the magnetic flux density. Third application example

This application example, as shown in Figure 3, has a constitution approximately similar to that of the above-mentioned two application examples, and the same symbols are given to the common parts.

In this application example, the magnets 2 are placed on a mounting plate 9 with a thin plate shape, and the yoke 1 exists below them and is ascended and descended with respect to the magnets by the driving gear 7.

Since the magnetic circuit is closed, if the magnetic resistance in the gap between the yoke 1 and the magnets 2 is increased by the increase of the relative distance between them, the magnetic fluxes being generated to the target 5 from the magnets 2 are reduced. Utilizing this property, the magnetic resistance of the gap is increased by the incremental portion (Bt - Bt1) of the magnetic flux

density due to the consumption of the target 5, so that the incremental position of the magnetic flux density of the discharge atmosphere D can be canceled.

Also, needless to say, the present invention can also be applied to target structures other than the parallel tabular target structure used in the above-mentioned application examples. Also, if a magnetic flux detecting sensor is mounted at the target and the error from a target value is amplified and fed back to the magnetic flux variable means, the magnetic fluxes can also be corrected at real time. (Effects of the invention)

According to the present invention, with the installation of the above magnetic flux variable means, a sputtering device that always induces a stable magnetron discharge, regardless of the sectional shape of a target and its amount being consumed, and can repeatedly, continuously prepare a thin film with equal qualities can be provided.

4. Brief description of the figures

Figures 1-3 are respectively outlined cross sections showing the first to third application examples of the present invention. Figure 4 is an illustrative diagram

showing the operation.

1 Yoke

2 Magnet

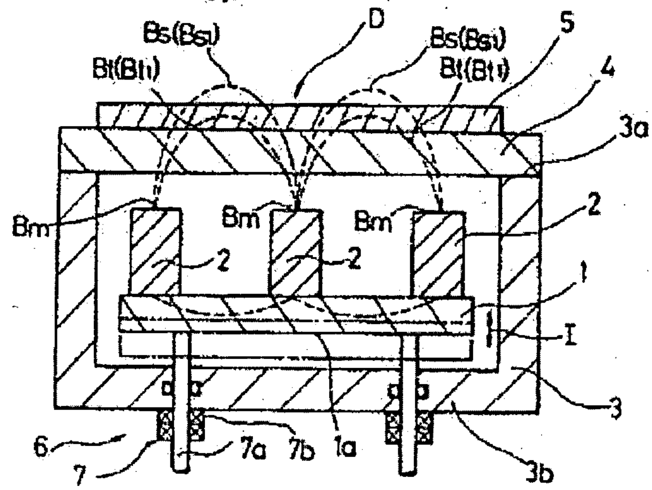
5 Magnetic material target

6 Magnetic flux variable means

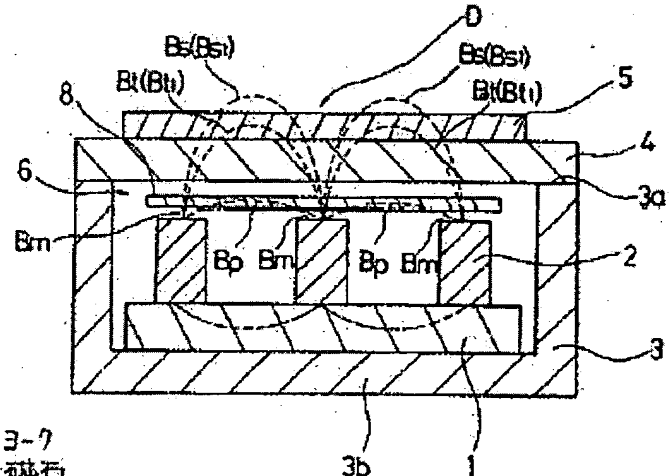
7 Driving gear

8 Magnetic flux short-circuit member (short circuit plate)

第 1 図

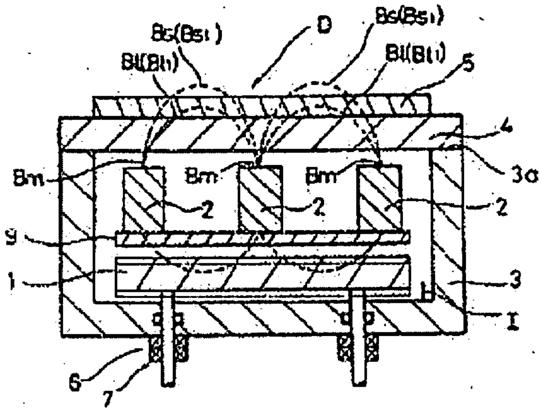


第 2 図



1…ヨーク
2…磁石
5…磁性体ターゲット
6…磁界可変手段
7…駆動装置
8…磁束短絡部材(短絡板)

第 3 図



第 4 図

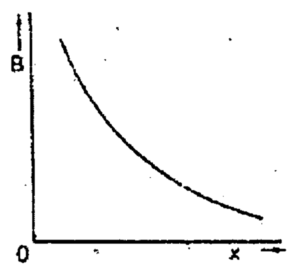


Figure 2:

1 Yoke

2 Magnet

5 Magnetic material target

6 Magnetic flux variable means

7 Driving gear

8 Magnetic flux short-circuit member (short circuit plate)